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ENVIRONMENTAL PROTECTION AGENCY **6560-50-P**

[EPA-HQ-OAR-2015-0091; FRL-9924-65-OAR]

Notice of Opportunity to Comment on an Analysis of the Greenhouse Gas Emissions Attributable to Production and Transport of Pennycress (Thlaspi Arvense) Oil for Use in Biofuel Production

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice.

SUMMARY: In this Notice, the Environmental Protection Agency (EPA) is inviting comment on its analysis of the greenhouse gas (GHG) emissions attributable to the production and transport of *Thlaspi arvense* ("pennycress") oil feedstock for use in making biofuels such as biodiesel, renewable diesel, and jet fuel. This notice explains EPA's analysis of the production and transport components of the lifecycle GHG emissions of biofuel made from pennycress oil, and describes how EPA may apply this analysis in the future to determine whether biofuels produced from pennycress oil meet the necessary GHG reductions required for qualification as renewable fuel under the Renewable Fuel Standard program. Based on this analysis, we anticipate that biofuels produced from pennycress oil could qualify as biomass-based diesel or advanced biofuel if typical fuel production process technologies are used.

DATES: Comments must be received on or before **[insert date 30 days after publication in the Federal Register]**.

ADDRESSES: Submit your comments, identified by Docket ID No. EPA-HQ-OAR-2015-0091, by one of the following methods:

- http://www.regulations.gov. Follow the on-line instructions for submitting comments.

- Email: a-and-r-docket@epa.gov, Attention Air and Radiation Docket ID No. EPA-HQ-OAR-2015-0091.
- Mail: Air and Radiation Docket, Docket No. EPA-HQ-OAR-2015-0091, Environmental Protection Agency, Mail code: 28221T, 1200 Pennsylvania Ave., N.W., Washington, DC 20460.
- Hand Delivery: EPA Docket Center, EPA/DC, EPA WJC West, Room 3334, 1301 Constitution Ave., NW, Washington, DC, 20460, Attention Air and Radiation Docket, ID No. EPA-HQ-OAR-2015-0091. Such deliveries are only accepted during the Docket's normal hours of operation, and special arrangements should be made for deliveries of boxed information.

Instructions: Direct your comments to Docket ID No. EPA-HQ-OAR-2015-0091. EPA's policy is that all comments received will be included in the public docket without change and may be made available online at www.regulations.gov, including any personal information provided, unless the comment includes information claimed to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Do not submit information that you consider to be CBI or otherwise protected through www.regulations.gov or e-mail. The www.regulations.gov website is an "anonymous access" system, which means EPA will not know your identity or contact information unless you provide it in the body of your comment. If you send an e-mail comment directly to EPA without going through www.regulations.gov, your e-mail address will be automatically captured and included as part of the comment that is placed in the public docket and made available on the Internet. If you submit an electronic comment, EPA recommends that you include your name and other contact information in the body of your comment and with any disk or CD-ROM you submit. If EPA cannot read your comment due to technical difficulties and cannot contact you for clarification, EPA may not be able to consider your comment. Electronic files should avoid the use of special characters, any form of encryption, and be free of any defects or viruses. For additional information about EPA's public docket visit the EPA Docket Center homepage at http://www.epa.gov/epahome/dockets.htm.

Docket: All documents in the docket are listed in the www.regulations.gov index. Although listed in the index, some information is not publicly available, e.g., CBI or other information for which disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy. Publicly available docket materials are available either electronically in www.regulations.gov or in hard copy at the Air and Radiation Docket, EPA/DC, EPA WJC West, Room 3334, 1301 Constitution Ave., NW, Washington, DC. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566-1744, and the telephone number for the Air and Radiation Docket is (202) 566-1742.

FOR FURTHER INFORMATION CONTACT: Jon Monger, Office of Transportation and Air Quality, Mail Code: 6406J, U.S. Environmental Protection Agency, 1200 Pennsylvania Avenue, NW, 20460; telephone number: (202) 564-0628; fax number: (202) 564-1686; email address: *monger.jon@epa.gov*.

SUPPLEMENTARY INFORMATION:

This notice is organized as follows:

I. Introduction

As part of changes to the Renewable Fuel Standard (RFS) program regulations published on March 26, 2010[1] (the "March 2010 rule"), EPA specified the types of renewable fuels eligible to participate in the RFS program through approved fuel pathways. Table 1 to 40 CFR 80.1426 of the RFS regulations lists three critical components of an approved fuel pathway: (1) fuel type; (2) feedstock; and (3) production process. Fuel produced pursuant to each specific combination of the three components, or fuel pathway, is designated in Table 1 to 40 CFR 80.1426 as eligible for purposes of the Clean Air Act's (CAA) requirements for greenhouse gas (GHG) reductions to qualify as renewable fuel or one of three subsets of renewable fuel (biomass-based diesel, cellulosic biofuel, or advanced biofuel). EPA may also independently approve additional fuel pathways not currently listed in Table 1 to 40 CFR 80.1426 for participation in the RFS program, or a third-party may petition for EPA to evaluate a new fuel pathway in accordance with 40 CFR 80.1416.

EPA's lifecycle analyses are used to assess the overall GHG impacts of a fuel throughout each stage of its production and use. The results of these analyses, considering uncertainty and the weight of available evidence, are used to determine whether a fuel meets the necessary GHG

[1] See 75 FR 14670.

reductions required under the CAA for it to be considered renewable fuel or one of the subsets of renewable fuel. Lifecycle analysis includes an assessment of emissions related to the full fuel lifecycle, including feedstock production, feedstock transportation, fuel production, fuel transportation and distribution, and tailpipe emissions. Per the CAA definition of lifecycle GHG emissions, EPA's lifecycle analyses also include an assessment of significant indirect emissions, such as indirect emissions from land use changes, agricultural sector impacts, and production of co-products from biofuel production.

Pursuant to 40 CFR 80.1416, EPA received a petition from Arvens Technology, Inc., with contents claimed as confidential business information (CBI), requesting that EPA evaluate the lifecycle GHG emissions for biofuels produced using *Thlaspi arvense* ("pennycress") oil, and that EPA provide a determination of the renewable fuel categories, if any, for which such biofuels may be eligible. As an initial step in this process, EPA has conducted an evaluation of the GHG emissions associated with the production and transport of pennycress when it is used as a biofuel feedstock, and is seeking public comment on the methodology and results of this evaluation.

EPA expects to consider comments received and then use the information to evaluate petitions received pursuant to 40 CFR 80.1416 that propose to use pennycress oil as a feedstock for the production of biofuel, and that seek an EPA determination regarding whether such biofuels qualify as renewable fuel under the RFS program. In evaluating such petitions, EPA will consider the GHG emissions associated with petitioners' biofuel production processes, as well as emissions associated with the transport and use of the finished biofuel, in addition to the

GHG emissions associated with the production and transport of pennycress feedstock in determining whether petitioners' proposed biofuel production pathway satisfies CAA renewable fuel lifecycle GHG reduction requirements.

II. Analysis of GHG Emissions Associated with use of Pennycress Oil as a Biofuel Feedstock

EPA has evaluated the lifecycle GHG impacts of using pennycress oil as a biofuel feedstock, based on information provided in the petition and other data gathered by EPA. For these analyses, we used a similar approach to that used for camelina oil in a rule published on March 5, 2013[2] (the "March 2013 rule"). In that rulemaking, EPA determined that several renewable fuel pathways using camelina oil feedstock meet the required 50% lifecycle GHG reduction threshold under the RFS for biomass-based diesel and advanced biofuel because the GHG emissions performance of camelina-based fuels is at least as good as that modeled for fuels made from soybean oil.

EPA believes that new agricultural sector modeling is not needed to evaluate the lifecycle GHG impacts of using pennycress oil as a biofuel feedstock for purposes of making GHG reduction threshold determinations for the RFS program. This is in part because of the similarities of pennycress oil to soybean oil and camelina oil, and because pennycress is not expected to have significant land use change impacts. Instead of performing new agricultural sector modeling, EPA relied upon the soybean oil analysis conducted for the March 2010 rule to assess the relative GHG impacts of growing and transporting pennycress oil for use as a biofuel

[2] 78 FR 14190.

feedstock. We have looked at every component of the agricultural sector GHG emissions from pennycress oil production, including land use change, crop inputs, crushing and oil extraction, and feedstock distribution. For each component, we believe that the GHG emissions are less than or equal to the emissions from that component of soybean oil production. Based on this analysis (described below), we propose to evaluate the agricultural sector GHG emissions impacts of using pennycress oil in responding to petitions received pursuant to 40 CFR 80.1416 by assuming that GHG emissions are similar to those associated with the use of soybean oil for biofuel production. We invite comment on this proposed approach.

A. Feedstock Production

1. <u>Background</u>

Pennycress is an oilseed crop of the flowering mustard plant family Brassicaceae. Pennycress is native to Eurasia and has been in North America for approximately 200 years. It is widespread throughout temperate regions, and can grow in cropland, fallow land, and along roadsides, among other places.[3] It is a winter annual that flowers in spring.[4] The fertilized flowers produce seedpods, with each plant producing up to 15,000 seeds. These seeds have a high oil content.[5]

[3] Pennycress Resource Network, http://www.wiu.edu/pennycress/agronomics/. Accessed February 19, 2015.
[4] Fan, J. et al. (2013) "A life cycle assessment of pennycress (*Thlaspi arvense* L.) –derived jet fuel and diesel." Biomass and Bioenergy, 55:87-100.
[5] Moser, B.R., et al. (2009) "Production and evaluation of biodiesel from field pennycress (*Thlaspi arvense* L.) oil." Energy and Fuels, 23:4149-4155.

Pennycress oil is not edible, and currently has no commercial markets, but it has many potential uses. Pennycress oil has high concentrations of erucic acid,[6] which could make it useful for industrial purposes such as lubricants and textiles softeners.[7] In addition, pennycress seed meal has been investigated for use as a biofumigant.[8] There is currently interest in developing pennycress for use as a biofuel crop because it can be grown in the winter between seasons for other major crops such as soybeans and corn, requires little inputs, and has a high oil content.[9] In addition, growing pennycress can help preserve soil quality and water quality by reducing runoff and erosion.[10] Because of the interest in pennycress as a biofuel crop, pennycress growth and fuel production are areas of active research at the United States Department of Agriculture (USDA), Western Illinois University, and in private industry.[11]

2. Volume Potential

Based on information currently available, pennycress is expected to be primarily planted in the U.S. as a rotation crop with corn and soybeans,[12] on acres that would otherwise remain fallow (see Table 1). Current research indicates that planting pennycress in lieu of fallowing

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[6] Moser, B.R., et al. (2009) "Production and evaluation of biodiesel from field pennycress (*Thlaspi arvense* L.) oil." Energy and Fuels, 23:4149-4155

[7] USDA Economic Research Service, "Crambe, industrial rapeseed, and tung provide valuable oils," September 1996. Available at: http://www.ers.usda.gov/ersDownloadHandler.ashx?file=/media/933430/ius6c_002.pdf. Accessed July 8, 2014.

[8] Vaughn, S.F., et al. (2005) "Biofumigant compounds released by field pennycress (*Thlaspi arvense*) seedmeal." Journal of Chemical Ecology, 31(1):167-177.

[9] Moser, B.R., et al. (2009) "Production and evaluation of biodiesel from field pennycress (*Thlaspi arvense* L.) oil." Energy and Fuels, 23:4149-4155.

[10] Christiansen, J. and C. Taylor, "Cover crops improve soil health, help farmers weather drought." USDA National Resources Conservation Service. Available at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/home/?cid=STELPRDB1083051. Accessed January 26, 2015.

[11] Evangelista, R.L. et al. (2012) "Extraction of pennycress (*Thlaspi arvense* L.) seed oil by full pressing." Industrial Crops and Products, 37:76-81; Moser, B.R. et al. (2009) "Composition and physical properties of cress (*Lepidium sativum* L.) and field pennycress (*Thlaspi arvense* L.) oils." Industrial Crops and Products 30:199-205; Moser, B.R., et al. (2009) "Production and evaluation of biodiesel from field pennycress (*Thlaspi arvense* L.) oil." Energy and Fuels, 23:4149-4155.

[12] Moser, B.R., et al. (2009) "Production and evaluation of biodiesel from field pennycress (*Thlaspi arvense* L.) oil." Energy and Fuels, 23:4149-4155.

would not decrease the next soybean yield.[13] Since substituting fallow land with pennycress production would not typically displace another crop, EPA does not believe new acres would need to be brought into agricultural use to increase pennycress production.

Table 1—Example Soybean, Corn and Pennycress Rotation

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Year 1				Corn Planting					Corn Harvest/ Pennycress Planting			
Year 2					Pennycress Harvest	Soybean Planting				Soybean Harvest		

Shaded cells indicate fallow months

Dark shaded cells indicate growing months

Pennycress is currently cultivated on approximately 1,000 acres of land in the U.S., in Illinois, Iowa, Ohio, and Indiana.[14] EPA anticipates that these states are most likely to have large scale increases in pennycress production in the short term, because pennycress is already cultivated there. Also, these states have high soybean acreage and the appropriate climate for pennycress to be cultivated as a winter crop before soybean planting. Based on USDA data on soybean acreage in 2014, pennycress could be cultivated on 31 million acres in these states.[15] However, industry is also considering cultivating pennycress in other Midwest corn-belt states,

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[13] Phippen, W.B. et al. (2010) "Planting date, herbicide, and soybean rotation studies with field pennycress (*Thlaspi arvense* L.)" Association for the Advancement of Industrial Crops Annual Meeting, Fort Collins, CO. September 19-22, 2010. Poster. Available at: http://www.wiu.edu/pennycress/current-experiments/Planting%20Date%202010.pdf

[14] Correspondence with Terry Isbell of USDA Agricultural Research Service (ARS).

[15] 2014 soybean acreage from USDA, National Agricultural Statistics Service, http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1000.

and according to their estimates, 40 million acres could be cultivated.[16] Industry projects that by 2022, approximately 2 million of these available acres will be used for pennycress production.[17] Based on our calculations of the potential biodiesel production from pennycress, as described below, we do not anticipate demand for pennycress oil to be greater than can be satisfied by available fallow acres.

Average yields of 1,000-2,000 pounds of pennycress seed per acre have been achieved on test plots,[18] and are in line with expected yields of other oilseeds such as canola/rapeseed. Based on a mid-range yield of 1,500 pounds per acre and current acreage (1,000 acres), approximately 55,000 gallons of pennycress-based biodiesel could be produced from existing pennycress acres (assuming 0.28 pounds of pennycress oil can be extracted from a pound of seed, and 7.6 pounds of oil produces 1 gallon of biodiesel).[19] Yield improvements of pennycress are expected to approach the yield growth rates of other oilseed crops over the next decade, as experience with growing pennycress improves cultivation practices and the application of existing technologies are more widely adopted.[20] Assuming a yield growth rate of 2% per year, starting with a yield of 1,500 pounds per acre, yields would be 1,800 pounds per acre by 2022. Based on this yield and the industry's projection of 2 million acres of pennycress in 2022, approximately 133 million

[16] Arvens Technology, Inc., "About Pennycress." Available at: http://arvenstech.com/about.html. Accessed February 23, 2015.
[17] Petition from Arvens Technology, Inc., June 2012.
[18] Isbell, T. and S. Chermak (2010). "*Thlaspi arvense* (Pennycress) germination, development and yield potential." Advancement of Industrial Crops Annual Meeting, Fort Collins, CO. September 19-22, 2010. Abstract, p. 29. Available at: http://www.aaic.org/10program.htm
[19] For biodiesel produced from soybean oil, 7.6 pounds of oil are also needed for one gallon of biodiesel. According to the petition, 0.28 lbs of pennycress oil can be extracted from a pound of seed. A similar value of 0.29 lbs oil per pound of seed is used by: Fan, J. et al. (2013) "A life cycle assessment of pennycress (*Thlaspi arvense* L.) –derived jet fuel and diesel." Biomass and Bioenergy, 55:87-100.
[20] Correspondence with Terry Isbell of USDA ARS.

gallons (MG) of pennycress-based biodiesel could be produced.[21] If investment in new seed technology allows yields to increase to levels projected by industry (4,000 pounds per acre), significantly more pennycress-based renewable fuels could be produced.[22] For the purposes of this analysis, we took a conservative approach in terms of lifecycle GHG impacts of crop production by assuming the lower yield estimate of 1,800 pounds per acre.

3. Indirect Impacts

Unlike commodity crops that are tracked by USDA, pennycress does not have a well-established, internationally traded market that would be significantly affected by an increase in pennycress-based biofuels. Based on information provided in the petition itself, from USDA, and in the scientific literature, returns on pennycress are expected to be approximately $120 per acre, given average yields of 1,800 pounds per acre and a contract price of $0.15 per pound (See Table 2). For comparison purposes, the USDA estimates of corn and soybean returns, including operating costs but not overhead costs such as hired labor, were between $206 and $440 per acre in 2013.[23] Over time, advancements in seed technology, improvements in planting and harvesting techniques, and changes in input usage could significantly increase future pennycress yields and returns, but it is unlikely the returns to farmers from pennycress will ever compete with the returns from corn, soybeans or other widely traded commodity crops. In addition, because pennycress is expected to be grown on fallow land, it will not impact other commodities through land competition. For these reasons, EPA has determined that, unlike a crop such as

[21] Different amounts of feedstock oil are needed to produce a gallon of different types of fuel (biodiesel, renewable diesel, and renewable jet fuel). For simplicity, we only estimated the potential biodiesel production here, which requires the least amount of feedstock oil per gallon of fuel.
[22] Petition from Arvens Technology, Inc., June 2012.
[23] USDA Economic Research Service, Commodity Costs and Returns. Available at: http://www.ers.usda.gov/data-products/commodity-costs-and-returns.aspx. Accessed June 12, 2014.

soybeans, production of pennycress-based biofuels is not expected to have a significant impact on other agricultural commodity markets and consequently would not result in significant indirect impacts, including indirect land use changes.

Table 2—Pennycress Costs and Returns, per acre[24]

	2022 Pennycress (1800 lbs/acre)
Inputs	
Seed	
Pennycress seed (cost: $1/lb)	$13.00 (13 lbs/ac)
Fertilizer	
Nitrogen Fertilizer (cost: $1/lb)	$50.00
Phosphate Fertilizer (cost: $1/lb)	$20.00
Potassium Fertilizer (cost: $1/lb)	$20.00
Sub-Total	**$103.00**
Logistics	
Planting Trip	$10.00
Harvest & Hauling	$36.00
Total Cost	$149.00
Yields (lbs/acre)	1800
Price (per lb)	$0.15
Total Revenue	**$270.00**
Returns	**$121**

[24] Based on information from Arvens Technology, Inc., USDA, scientific literature, and EPA calculations.

Although we expect most pennycress used as a renewable fuel feedstock for the RFS program would be grown in the U.S. and Canada, we expect that pennycress grown in other countries would also not have a significant impact on other agricultural commodity markets and would therefore not result in significant indirect GHG emissions.

4. Crop Inputs

As part of our analysis of the GHG impacts from growing pennycress, we compared crop inputs for pennycress to those for soybeans. Inputs compared include nitrogen fertilizer, phosphorus fertilizer, potassium fertilizer, herbicide, pesticide, diesel, and gasoline.[25] We also looked at the N_2O emissions from both the nitrogen fertilizer inputs and the crop residues associated with pennycress.

Current literature suggests that only minimal fertilizer inputs are needed to grow pennycress.[26] Information from USDA and other sources suggests that approximately 50 lbs per acre nitrogen fertilizer may be required for successful pennycress cultivation, although information from the petitioner indicates that no additional nitrogen fertilizer would be needed.[27] Some current trials have not required the addition of phosphorus or potassium fertilizer since these nutrients have been available in the soil after corn plantings.[28] However, it is possible that when pennycress is produced at a commercial scale, some amount of phosphorus and potassium

[25] Diesel and gasoline are used for planting and harvesting pennycress. These values assume that no irrigation is needed.
[26] Moser, B.R., et al. (2009) "Production and evaluation of biodiesel from field pennycress (*Thlaspi arvense* L.) oil." Energy and Fuels, 23:4149-4155.
[27] 50 lb N/acre from: Rukavina, H. et al. (2011) "The effect of nitrogen rate on field pennycress seed yield and oil content." Association for the Advancement of Industrial Crops 23rd Annual Meeting, Fargo, ND. September 11-14, 2011. Poster. Available at: http://www.wiu.edu/pennycress/current-experiments/Nitrogen%202011.pdf.
[28] Correspondence with Win Phippin, Western Illinois University.

might be added to replace the phosphorus or potassium that is removed from the soil. Therefore, Table 3 shows a range of potential input assumptions for pennycress production,[29] compared to the FASOM agricultural input assumptions for soybeans, which were used in our assessment of soybeans for the March 2010 rule. From the March 2010 rule, we used soybean projected yields for 2022 of 1,500 to 3,000 lbs of seed per acre. For pennycress, we used projected 2022 yields of 1,800 lbs of seed per acre.

Pennycress has a higher percentage of oil per pound of seed than soybeans. Soybeans are approximately 18% oil by mass, therefore crushing one pound of soybeans yields 0.18 pounds of oil. In comparison, pennycress seeds can contain up to 34% oil, and mechanical crushing extracts approximately 28% oil.[30] The difference in oil yield was taken into account when calculating the emissions per ton of feedstock oil included in Table 3. As shown in Table 3, GHG emissions associated with agricultural inputs for pennycress and soybeans are similar when factoring in variations in oil yields per acre and fertilizer, herbicide, pesticide, and petroleum use.[31]

Table 3—Inputs for Pennycress and Soybean Production for Projected 2022 Yields[32]

[29] Arvens Technology, Inc.; Correspondence with USDA. For more information, see "Pennycress data and calculations – for docket" on Docket EPA-HQ-OAR-2015-0091.
[30] Petition from Arvens Technology, Inc., June 2012. A similar value of 0.29 lbs oil per pound of seed is used by: Fan, J. et al. (2013) "A life cycle assessment of pennycress (*Thlaspi arvense* L.) –derived jet fuel and diesel." Biomass and Bioenergy, 55:87-100.
[31] For more details on the greenhouse gas emissions associated with agricultural inputs, see "Pennycress data and calculations – for docket" on Docket EPA-HQ-OAR-2015-0091.
[32] The Intergovernmental Panel on Climate Change (IPCC) equations for N_2O emissions were updated since our earlier analysis of soybeans. We use the updated equations here.

	Pennycress, 0.9 tons/acre		Soybeans (varies by region)	
	Inputs (per acre)	Emissions (per ton pennycress oil)	Inputs (per acre)	Emissions (per ton soybean oil)
N2O	N/A	468.5 - 1049.5 kg CO2eq	N/A	449.0 - 661.1 kg CO2eq
Nitrogen Fertilizer	0 - 50 lbs	0 - 326.5 kg CO2eq	3.5 - 8.2 lbs	23.2 - 79.1 kg CO2eq
Phosphorus Fertilizer	0 - 20 lbs	0 - 44.6 kg CO2eq	5.4 - 21.4 lbs	13.5 - 64.8 kg CO2eq
Potassium Fertilizer	0 - 20 lbs	0 - 29.5 kg CO2eq	3.1 - 24.3 lbs	5.3 - 48.5 kg CO2eq
Herbicide	0 - 0 lbs	0 - 0 kg CO2eq	0.0 - 1.3 lbs	2.4 - 69.6 kg CO2eq
Pesticide	0 - 0 lbs	0 - 0 kg CO2eq	0.1 - 0.8 lbs	12.4 - 50.2 kg CO2eq
Diesel	1 - 1 gal	52.3 - 52.3 kg CO2eq	3.8 - 8.9 gal	227.9 - 622.3 kg CO2eq
Gasoline	0 - 0 gal	0 - 0 kg CO2eq	1.6 - 3.0 gal	93 - 151.4 kg CO2eq
Total		521 - 1502 kg CO2eq		961 - 1443 kg CO2eq

5. **Potential Invasiveness**

Pennycress has naturalized in all of the continental United States,[33] and is not listed on the federal noxious weed list.[34] However, nine states currently have pennycress listed on a restricted weed list, indicating limitations on the use of the plant in those states.[35] A weed risk assessment by USDA found that pennycress has a high risk of invasiveness, and a high probability of impacting production systems such as agriculture, nurseries, forest plantations, and orchards.[36] However, unlike some other biofuel feedstocks evaluated under the RFS program for invasiveness, USDA found no evidence of pennycress causing impacts in natural systems or anthropogenic systems such as cities, suburbs, or roadways. Based on the potential risk to production systems, and in consultation with USDA, the use of pennycress as a biofuel feedstock raises concerns about its threat of invasiveness and whether its production could require remediation activities that would cause additional GHG emissions. Therefore, similar to EPA's

[33] USDA Animal and Plant Health Inspection Service. "Weed risk assessment for *Thlaspi arvense* L. (Brassicaceae) – Field pennycress," [Forthcoming].
[34] USDA (2014). "Federal Noxious Weed List." Available at: http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/weedlist.pdf
[35] USDA Agricultural Marketing Service (2014). "State Noxious-Weed Seed Requirements Recognized in the Administration of the Federal Seed Act." Available at: http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5090172. Producers interested in growing pennycress in these states should consult with the appropriate federal, state, and local authorities.
[36] USDA Animal and Plant Health Inspection Service. "Weed risk assessment for *Thlaspi arvense* L. (Brassicaceae) – Field pennycress," [Forthcoming]. Traits that contributed to this result are that pennycress is a prolific seed producer, forms a persistent seed bank, can cause yield losses of field crops, and is poisonous to livestock.

actions with respect to other biofuel feedstocks found to present invasiveness risks, EPA anticipates that any petition approvals for renewable fuel pathways involving the use of pennycress oil as feedstock will include requirements associated with mitigating risks associated with invasiveness. Because pennycress does not pose as great an invasiveness risk as *Arundo donax* or *Pennisetum purpureum*, EPA believes that monitoring and reporting requirements similar to those for *Arundo donax* and *Pennisetum purpureum* would be appropriate, but does not expect to apply all of the Risk Management Plan (RMP) requirements that exist for those feedstocks. We would expect to impose monitoring and reporting requirements similar to 40 CFR 80.1450 (b)(1)(x)(A)(*1*)(*i*), (*ii*), (*iii*), and (*v*) and 80.1450 (b)(1)(x)(A)(*3*), (*4*), (*5*), and (*7*). In addition, a letter documenting the feedstock grower's compliance with all of the relevant federal, state, regional, and local requirements related to invasive species would be required. With these requirements in place, we would assume that there are no GHG emissions associated with potential invasiveness when pennycress is used as a biofuel feedstock. EPA is taking comment on the invasiveness concerns of pennycress and the appropriateness of the referenced requirements in mitigating those concerns.

6. <u>Crushing and Oil Extraction</u>

EPA evaluated the seed crushing and oil extraction process and compared the lifecycle GHG emissions from this stage for soybean oil and pennycress oil. EPA assumed the processing of pennycress would be similar to soybeans, canola, and camelina. Because pennycress seeds produce more oil per pound than soybeans, the GHG emissions associated with crushing and oil extraction are lower for pennycress than soybeans per pound of feedstock oil produced.

There is not a significant amount of industry data on energy used for crushing and oil extraction of pennycress. Based on data provided in the petition submitted, and EPA's standard emissions factors for electricity and natural gas, we estimate that the GHG emissions from crushing and oil extraction are 80 kgCO2e/ton pennycress oil. For comparison, in the analysis for the March 2010 final rule, the lifecycle GHG emissions from crushing and oil extraction were estimated to be 426 kgCO2e/ton soybean oil. As a conservative estimate, we propose to assume that the GHG emissions related to crushing and oil extraction are the same for pennycress as for soybeans.

Similar to soybeans, a press cake is also produced when pennycress is crushed and the oil is extracted. In our modeling of soybean oil for the March 2010 RFS rule, the FASOM and FAPRI-CARD models included the use of the soy meal (sometimes referred to as press cake) co-product as livestock feed. In our modeling, the use of the soy meal as livestock feed displaced the need for other similar feed products and therefore impacted the relative prices and production of crop and livestock products. These crop and livestock impacts were reflected in the land use change, livestock and agricultural sector GHG emissions impacts estimated for biofuels produced from soybean oil. Although EPA did not conduct modeling to isolate the GHG impacts of the soy meal co-product, we believe that overall the soy meal co-product lowered the GHG emissions associated with soybean oil-based biofuels. Similarly, we believe that any use of the pennycress press cake would provide an additional benefit (i.e., lower GHG emissions) not reflected in our lifecycle GHG emissions analysis of pennycress oil. Little is known at this time about the possible beneficial use of pennycress press cake. Pennycress press cake contains glucosinolates, which may be toxic to animals in large concentrations.[37] However, the heat produced from crushing pennycress seeds may reduce the toxicity of the press cake,[38] or pennycress press cake could be mixed in low amounts with other seed meal for use as animal feed.[39] Alternatively, pennycress press cake could be used as a biofumigant.[40] Based on our analysis of pennycress oil, which does not consider use of the press cake, we have found that the agricultural, livestock and land use change emissions associated with producing pennycress oil are less than or equal to the corresponding emissions associated with producing soybean oil. Therefore, any beneficial use of the pennycress press cake (e.g., as livestock feed or boiler fuel) would only serve to make the GHG emissions associated with pennycress oil even lower than the corresponding emissions for soybean oil.

B. Feedstock Distribution

EPA's assessment, based on the following reasoning, is that GHG emissions from feedstock distribution will be the same for pennycress as such emissions for soybeans. Because pennycress contains more oil per pound of seed, as discussed above, the energy needed to move the pennycress before oil extraction would be lower than soybeans per ton of oil produced. To the extent that pennycress is grown on more disperse fallow land than soybeans and would need to be transported further, the energy needed to move the pennycress could be higher than

[37] Moser, B.R. (2012) "Biodiesel from alternative oilseed feedstock: camelina and field pennycress." Biofuels, 3:193-209.
[38] Fan, J. et al. (2013) "A life cycle assessment of pennycress (*Thlaspi arvense* L.) –derived jet fuel and diesel." Biomass and Bioenergy, 55:87-100.
[39] Moser, B.R. (2012) "Biodiesel from alternative oilseed feedstock: camelina and field pennycress." Biofuels, 3:193-209. It is important to note that all animal feed products must be approved by the U.S. Food and Drug Administration (FDA) before they can be sold in the United States. Nothing in EPA's analysis should be construed as an official federal government position regarding the approval or disapproval of pennycress press cake as an animal feed. Only FDA is authorized to make that determination.
[40] Vaughn, S.F., et al. (2005) "Biofumigant compounds released by field pennycress (*Thlaspi arvense*) seedmeal." Journal of Chemical Ecology, 31(1):167-177.

soybeans. Therefore, we believe we may assume for purposes of GHG emissions assessment that the GHG emissions associated with transporting pennycress and soybeans to crushing facilities will be the same. Pennycress and soybean oils are quite similar in terms of density and energy content; therefore, we also assumed that the GHG emissions from transporting the oil from a crushing facility to a biofuel production facility would be the same for the two different feedstocks.

C. Summary of Agricultural Sector GHG Emissions

Compared to soybean oil, pennycress oil has less than or equal GHG emissions per ton of oil from crop inputs, crushing and oil extraction, and direct and indirect land use change. Pennycress and soybean oils are also likely to have similar GHG emissions from feedstock distribution. Therefore, we believe that the feedstock production and transport portion of the lifecycle GHG emissions associated with pennycress are likely to be similar to or less than the GHG emissions for the corresponding portion of the lifecycle analysis for soybean oil. EPA's purpose in evaluating petitions under 40 CFR 80.1416 is not to prepare a precise lifecycle GHG emissions analysis of every fuel type, but to gather sufficient information on which to inform its decision of whether proposed biofuels qualify under the program in terms of lifecycle GHG emissions reduction. Based on our comparison of pennycress oil to soybean oil, EPA proposes to use, in its future evaluations of petitions proposing to use pennycress oil as a feedstock for biofuel production, an estimate of the GHG emissions associated with the cultivation and transport of pennycress oil that is the same as that which we have used for soybean oil, on a per ton of oil basis. Although EPA could conduct a more precise analysis, we do not believe it is necessary for purposes of the determinations EPA must make in responding to petitions. EPA solicits comment on this proposed approach.

D. Fuel Production and Distribution

Pennycress oil has physical properties that are similar to soybean and camelina oil, and is suitable for the same conversion processes as these feedstocks. In addition, the fuel yield per pound of oil is expected to be the same for each of these feedstocks. After reviewing comments received in response to this Notice, we will combine our evaluation of agricultural sector GHG emissions associated with the use of pennycress oil feedstock with our evaluation of the GHG emissions associated with individual producers' production processes and finished fuels to determine whether the proposed pathways satisfy CAA lifecycle GHG emissions reduction requirements for RFS-qualifying renewable fuels. Based on our evaluation of the lifecycle GHG emissions attributable to the production and transport of pennycress oil feedstock, EPA anticipates that fuel produced from pennycress oil feedstock through the same transesterification or hydrotreating process technologies that EPA evaluated for the March 2010 RFS rule for biofuel derived from soybean oil and the March 2013 RFS rule for biofuel derived from camelina oil would qualify for biomass-based diesel (D-code 4) RINs or advanced (D-code 5) RINs.[41] However, EPA will evaluate petitions for fuel produced from pennycress oil feedstock on a case-by-case basis.

III. Summary

[41] The transesterification process that EPA evaluated for the March 2010 RFS rule for biofuel derived from soybean oil feedstock is described in section 2.4.7.3 (Biodiesel) of the Regulatory Impact Analysis for the March 2010 RFS rule (EPA-420-R-10-006). The hydrotreating process that EPA evaluated for the March 2013 rule for biofuel derived from camelina oil feedstock is described in section II.A.3.b of the March 2013 rule (78 FR 14190).

EPA invites public comment on its analysis of GHG emissions associated with the production and transport of pennycress oil as a feedstock for biofuel production. EPA will consider public comments received when evaluating the lifecycle GHG emissions of biofuel production pathways described in petitions received pursuant to 40 CFR 80.1416 which use pennycress oil as a feedstock.

Dated: March 12, 2015.

Christopher Grundler,

Director, Office of Transportation and Air Quality.

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